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Agricultural Machinery – Multicrop Micromill – Methods of Test

BUREAU OF PRODUCT STANDARDS

DEPARTMENT OF TRADE & INDUSTRY PHILIPPINES

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National Foreword

This Philippine Agricultural Engineering Standards PAES 239:2008, Agricultural Machinery – Multicrop Micromill – Methods of Test was approved for adoption as Philippine National Standard by the Bureau of Product Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center.

Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) through the project "Multicrop Processing Machines for `Commercialization" funded by the Department of Science and Technology (DOST) through its Technology Innovation for Commercialization (TECHNICOM) Program and monitored by the Philippine Council for Agriculture, Forestry and Natural Resources Research Development (PCARRD).

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate mandatory requirements to conform to the standard.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

In the preparation of this standard, the following documents/publications were considered:

AMTEC Test and Evaluation Report MARVEL Corn Mill Model MCM 8-10

AMTEC Test and Evaluation Report SULTANA Rice/Corn Mill (For Corn) Model: SM-1.8

AMTEC Test and Evaluation Report VIRIÑA Hammer mill (for arrow root)

ASAE Standard: ASAE S319.1 Method of Determining and Expressing Fineness of Feed Materials By Sieving

Bautista, O. K. and H. B. Aycardo. Ginger: Its Production, Handling, Processing and Marketing with Emphasis on Export. Department of Horticulture, College of Agriculture, University of the Philippines Los Baños. 1979.

CIGR Handbook of Agricultural Engineering- Volume IV- Agro-Processing Engineering. Published by American Society of Agricultural Engineers. 1999.

Malinis, Arnulfo P., et al. Development of the Integrated Multicrop Processing System (Zero Waste Ginger Processing Technology). 2004.

PAES 226:2005 Agricultural Machinery – Micromill-Specifications

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ANNEXES

Agricultural Machinery – Multicrop Micromill – Methods of Test

1 Scope

This standard specifies the methods of test and inspection for multicrop micro mill used for grinding/milling of dried meals of ginger, arrow root, taro, cassava, sweet potato, potato, carrot, onion, garlic, pandan and lemon grass.

1.1 verify the mechanism, dimensions, materials, accessories of the multicrop micromill and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features

1.4 analyze the products of milling/grinding through laboratory analysis; and

1.5 report the results of the tests.

2 References

The following normative documents contain provisions, which through reference in this text constitute provisions of these standards:

ASTM E11 - Specifications for Wire-Cloth Sieves for Testing Purposes

PAES 103:2000 Agricultural Machinery – Method of Sampling

PAES 238:2008 Agricultural Machinery – Multicrop Micromill- Specifications

3 Definitions

For the purpose of this standard, the definitions given in PAES 238 and the following shall apply:

3.1
fineness
indicates the uniformity of grind in the resultant product

3.2
input capacity
weight of input test material per unit time, expressed in kilogram per hour

3.3
input time
time required to empty the hopper from full load per trial

3.4
labor requirement
number of man-day needed in the operation of the multicrop micromill

3.5
milling capacity
total amount of materials milled over the total time the multicrop micromill is in operation, expressed in kilogram per hour

3.6
milling efficiency
ratio between the amount of acceptable ground/milled product and the total milling recovery, expressed in percentage

3.7
milling recovery
ratio between the total amount of ground/milled product recovered and the total input materials, expressed in percentage

3.8
operating time
actual milling operation of the machine

3.9
prime mover
electric motor or internal combustion engine used to drive the machine

3.10
quality
refers to the fineness of the ground/milled product

3.11
running-in period
preliminary operation of the machine to make final adjustments prior to the conduct of test

3.12
sealed
free of openings that allow the entry or passage of moisture

4 General Conditions for Test and Inspection

4.1 Selection of multicrop micromill to be tested
Machine submitted for test shall be sampled in accordance with PAES 103.

4.2 Role of manufacturer/dealer

The manufacturer shall submit specifications and other relevant information about the multicrop micromill and shall abide with the terms and conditions set forth by an official testing agency.

4.3 Role of the operator

An officially designated operator shall be skilled and shall demonstrate, operate, adjust, and repair as the case maybe, related to the operation of the machine.

4.4 Test site conditions

The site should have ample provisions for material handling, temporary storage and workspace and suitable for normal working conditions.

4.5 Termination of Test

If during testing, the machine stops due to major component breakdown or malfunctions, the test engineer from the official testing agency shall terminate the test.

5 Test Preparation

5.1 Test instruments

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the multicrop micromill test is shown in Annex A.

5.2 Test material

Test materials to be used shall be any of the following crops; dried meals of ginger, arrow root, taro, cassava, sweet potato, potato, carrot, onion, garlic, pandan and lemon grass with the following characteristics:

5.2.1 Test material characteristics

5.2.1.1 Variety : locally grown (as much as possible single variety)

5.2.1.2 Condition : dried

5.2.1.3 Moisture Content : 12 -14 %

5.2.1.4 Quantity to be supplied

The amount of test material that will be used in performing the test shall be at least 75 % of the input capacity.

5.3 Sample Preparation

Prepare the test material in such a way that the test sample for each trial shall have identical characteristics in terms of variety and condition. Care should be taken so as to prevent alterations of the conditions of the test materials.

5.4 Running-in and preliminary adjustment

Before the start of the test, the multicrop micromill should have undergone running-in period wherein various adjustments of the multicrop micromill shall be made according to the

recommendation of the manufacturer. No other adjustments shall be permitted while the test is on-going.

6 Pre-test Observation

6.1 Verification of the manufacturer's technical data and information

This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the multicrop micromill in comparison with the list of manufacturer's technical data and information.

6.2 A plain and level surface shall be used as reference plane for verification of multicrop micromill dimensional specifications.

6.3 The items to be inspected and verified shall be recorded in Annex B.

7 Performance test

This is carried out to obtain actual data on overall machine performance.

7.1 Operation of the multicrop micromill

The multicrop micromill shall be operated at the recommended settings of the manufacturer. After each test trial, the milling area shall be cleaned and then prepared for the next test trial.

7.2 Test Trial

A minimum of three (3) test trials, with duration of at least 15 minutes per trial, shall be adopted.

7.3 Sampling

7.3.1 Sampling procedure for test materials

Before each test trial, randomly take three (3) 100-gram samples for determination of initial moisture content.

7.3.2 Sampling from the collecting bin

After each test trial, three (3) 250-gram samples shall be randomly collected from the collecting bin of the multicrop micromill to be analyzed in the laboratory.

7.3.3 Handling of Samples

All samples shall be placed in appropriate containers, properly labeled and sealed.

7.4 Data Collection

7.4.1 Duration of Test

The duration of each test trial shall start from loading of test materials into the hopper and ends after all the milled products are collected in the collecting bin.

7.4.2 Noise level

The noise emitted by the machine shall be measured using a noise level meter at the location of the operator and collector. The noise level shall be measured approximately 50 mm away from the ear level of the operator and collector.

7.4.3 Speed of Components

The speed of the rotating shafts of the major components of the multicrop micromill shall be taken using tachometer.

NOTE Measurements shall be taken with and without load for sub-clauses 7.4.2 and 7.4.3 as specified in Annex C. Measurements with load shall be randomly taken during the duration of each test trial.

7.4.4 Fuel/Power Consumption

Before the start of each trial, the fuel tank shall be filled to its capacity for internal combustion engines used as power source. After each test trial the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test. When filling up the tank, keep the tank horizontal so as not to leave empty space in the tank.

In case an electric motor is used as the prime mover, a power meter shall be used to measure electric energy consumption. Measurement shall be randomly taken during the duration of each test trial.

7.5 Data recording and observations

Record sheet for all data and information during the test is given in Annex C.

8 Laboratory Analysis

Laboratory analysis shall be made to determine moisture content and fineness of test material. The laboratory test data sheet to be used is given in Annex D.

8.1 Moisture Content

This shall be taken following the standard procedures for oven-dry method (wet basis).

8.1.1 For each test trial, select three (3) representative samples weighing at least 25 g of test materials and place them in the moisture can. The moisture cans shall be sealed to ensure that no moisture is lost or gained by the samples between the times they were weighed. Record the initial weight.

8.1.2 Dry the samples in the oven with temperature of 103 °C – 105 °C for at least 24 hours.

8.1.3 After removing the samples from the oven, it should be placed in desiccators and allowed to cool to ambient temperature.

8.1.4 Weigh each moisture cans including the dried sample. Record the final weight. Calculate the moisture content using the equation in Annex E.

8.2 Analysis of Ground Product

This shall be taken using Sieve Shaker Testing. A set of sieves as specified in ASTM E11 - Specifications for Wire-Cloth Sieves for Testing Purposes shall be used.

8.2.1 For each test trial, place the samples in a testing sieve shaker with a series of sieves screen.

8.2.2 Shake the samples for at least 5 minutes.

8.2.3 After shaking, remove the samples from each sieve screen. Weigh and record each weight.

8.2.4 Calculate the percent of ground/milled materials retained on each sieve screen.

8.2.5 Calculate the milling efficiency as follows:

8.2.5.1 For seasoning purposes, the percent of material retained on the 50 mesh sieve screen shall be used in the computation.

8.2.5.2 For flour purposes, the percent of materials retained on the pan shall be used in the computation.

9 Formula

The formulas to be used during calculations and testing are given in Annex E.

10 Test Report

The test report shall include the following information in the order given:

10.1 Title

10.2 Summary

10.3 Purpose and Scope of Test

10.4 Methods of Test

10.5 Description of the Machine

Table 1 – Machine Specifications

10.6 Results and Discussions

10.7 Observations (include pictures)

Table 2 –Performance test data

10.8 Name/s, signature/s and designation of test engineers

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

A.1	**Equipment**	
		Quantity
A.1.1	**Field**	
A.1.1.1	Tachometer (contact type or photo electric type) Range: 0 rpm to 5,000 rpm	1
A.1.1.2	Digital timers (range: 60 minutes) Accuracy: 0.1 sec	2
A.1.1.3	Tape measure (with maximum length of 5m)	1
A.1.1.4	Noise level meter Range: 30 dB (A) to 130 dB (A)	1
A.1.1.5	Portable digital scale (capacity: 100 kg) Scale divisions: 500 g or Weighing scale (capacity: 100 kg) Scale divisions: 500 g	1
A.1.1.6	Graduated cylinder (for engines) (500 ml capacity) or power meter (for electric motors) 60 Hz, 220 V	1
A.1.1.7	Camera	1
A.1.1.8	Vernier Caliper Accuracy: 0.1 mm	1
A.1.2	**Laboratory**	
A.1.2.1	Air Oven	1
A.1.2.2	Sieve Shaker	1
A.1.2.3	Electronic Balance Sensitivity: 0.1 g	1
A.1.2.4	Desiccators	
A.1.2.5	Sieves Screen ASTM E-11 #12, #16, #20, #30, #40, #50, Pan	
A.2	**Materials**	
A.2.1	Moisture cans	
A.2.2	Sample bags	
A.2.3	Labeling tags which include	
A.2.3.1	Date of test	
A.2.3.2	Multicrop micromill on test	
A.2.3.3	Sample source	
A.2.3.4	Variety	
A.2.3.5	Trial number	

Annex B
(informative)

Specifications of Multicrop Micromill

Name of Applicant/ Distributor: _____
Address: _____
Tel No: _____
Name of Manufacturer: _____
Address: _____
Tel No: _____

GENERAL INFORMATION

Make: _____ Type: _____
Serial No: _____ Brand/Model: _____
Production date of Multicrop Micromill to be tested: _____
Testing Agency: _____ Test Engineer: _____
Date of Test: _____ Location of Test: _____

Items to be inspected

ITEMS	Manufacturer's Specification	Verification by the Testing agency
B.1 Main structure		
B.1.1 Overall dimensions, mm		
B.1.1.1 length		
B.1.1.2 width		
B.1.1.3 height		
B.1.2 Weight, without prime mover (kg), if applicable		
B.2 Hopper		
B.2.1 Material		
B.2.2 Thickness, mm		
B.2.3 Height from the ground, mm		
B.2.4 Location		
B.3 Power Transmission		
B.3.1 Pulley		
B.3.1.1 Type		
B.3.1.2 Dimension, mm		
B.3.1.2 Speed Reducer Input Shaft		
B.3.1.2.1 Type		
B.3.1.2.2 Dimension, mm		
B.3.1.2.3 Speed Ratio		
B.4 Main Frame		
B.4.1 Material		
B.4.2 Thickness, mm		
B.4.3 Dimension, mm		
B.5 Milling Chamber		
B.5.1 Hammer mill type		
B.5.1.1 Material		

B.5.1.2 Number of beater		
B.5.2 Attrition mill type		
B.5.2.1 Plate used		
B.5.2.2 Material		
B.5.2.3 Diameter, mm		
B.5.2.4 Thickness, mm		
B.5.3 Roller mill type		
B.5.3.1 Number of rollers		
B.5.3.2 Length, mm		
B.5.3.3 Diameter, mm		
B.6 Screen		
B.6.1 Mesh Number		
B.6.2 Material		
B.7 Cyclone		
B.7.1 Material		
B.8 Collecting bin		
B.8.1 Material		
B.8.2 Dimension, mm		
B.9 Prime mover		
B.9.1 Electric motor		
B.9.1.1 Brand		
B.9.1.2 Make or manufacturer		
B.9.1.3 Serial No.		
B.9.1.4 Type		
B.9.1.5 Rated Power, kW		
B.9.1.6 Rated Speed, rpm		
B.9.1.7 Frequency, Hz		
B.9.1.8 Voltage		
B.9.1.9 Weight, kg		
B.9.2 Engine		
B.9.2.1 Brand		
B.9.2.2 Model		
B.9.2.3 Make or manufacturer		
B.9.2.4 Serial No.		
B.9.2.5 Type		
B.9.2.6 Rated Power, kW		
B.9.2.7 Rated Speed, rpm		
B.9.2.8 Displacement (cm^3)		
B.9.2.9 Cooling system		
B.9.2.10 Starting system		
B.9.2.11 Weight, kg		

Annex C
(informative)

Performance Test Data Sheet

Test Trial No. _____ Date: _____
Test Engineer: _____ Location: _____
Assistants: _____ Test Specimen: _____
Test Requested by: _____ Manufacturer: _____

C.1 Information on the Test Materials				
C.1.1 Crop				
C.1.2 Source				
C.1.3 Moisture Content				
C.2 Result of Performance Test				
ITEMS	**Trial 1**	**Trial 2**	**Trial 3**	**Ave.**
C.2.1 Weight of Input, kg				
C.2.2 Input time, s				
C.2.3 Input Capacity, kg				
C.2.4 Operating time, s				
C.2.5 Milling capacity, kg/h				
C.2.6 Milling recovery, %				
C.2.7 Milling efficiency, %				
C.2.8 Speed of Components, rpm				
C.2.8.1 Electric Motor				
C.2.8.1.1 Without load				
C.2.8.1.2 With load				
C.2.8.2 Main Shaft				
C.2.8.2.1 Without load				
C.2.8.2.2 With load				
C.2.8.3 Prime mover Shaft				
C.2.8.3.1 Without load				
C.2.8.3.2 With load				
C.2.9 Noise Level, dB(A)				
C.2.9.1 Without load				
C.2.9.2 With load				
C.2.10 Power Consumption				
C.2.10.1 Power, kW				
C.2.10.1.1 Without load				
C.2.10.1.2 With load				
C.2.10.2 Voltage, V				
C.2.10.2.1 Without load				
C.2.10.2.2 With load				
C.2.10.3 Current, A				
C.2.10.3.1 Without load				
C.2.10.3.2 With load				
C.2.11 Fuel consumption				
C.2.11.1 Fuel time, h				
C.2.11.2 Fuel consumed, L				

C.3 Rate the following observations:

Items	Rating*				
	1	2	3	4	5
C.3.1 Ease of loading					
C.3.2 Ease of cleaning parts					
C.3.3 Ease of adjusting and repair of parts					
C.3.4 Ease of collecting output					
C.3.5 Ease of transporting the machine					
C.3.6 Safety					
C.3.7 Vibration					

*1 – Very good
2 - Good
3 - Satisfactory
4 - Poor
5 – Very poor

C.4 Other Observations:

Annex D
(informative)

Laboratory Test Data Sheet

Machine Tested: _____

Analyzed by: _____

D.1 Determination of Moisture Content

Sample Material	Initial Weight, W_{is}				Final Weight, W_{fs}				% MC			
	Trial 1	Trial 2	Trial 3	Ave	Trial 1	Trial 2	Trial 3	Ave	Trial 1	Trial 2	Trial 3	Ave
Crop used												
Input test material meal												

D.2 Analysis of Ground/Milled Product

ASTM E11 Standard Testing Sieve	Weight of Material Retained			Percent of Material Retained		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
12						
16						
20						
30						
40						
50						
pan						
Total						

Annex E
(informative)

Formula Used During Calculations and Testing

E.1 Input Capacity, C_i (kg/h)

$$Ci = \frac{Wi}{Ti}$$

where:

C_i = Input capacity, kg/h
W_i = Weight of input material, kg
T_i = Input time, h

E.2. Milling Capacity, C_M (kg/h)

$$C_M = \frac{Wo}{To}$$

Where:

C_M = Milling Capacity, kg/h
Wo = Total weight of ground material, kg
To = Total operating time, h

E.3 Milling recovery, MR (%)

$$MR = \frac{\text{Total ground/milled product, kg}}{\text{Total weight of input material, kg}} x100$$

E.4 Milling efficiency, Eff (%)

$$Eff = \frac{FP, \%}{MR, \%} x100$$

where:

Eff = milling efficiency, %
FP = Fine milled product (percent of materials retained on 50 mesh sieve screen for food seasoning purposes)
= Fine milled product (percent of materials retained on the pan for flour purposes)
MR = Milling recovery, %

E.5 Moisture Content, MC (%)

$$MC = \frac{W_{is} - W_{fs}}{W_{is}} x100$$

where:

MC = moisture content, %
W_{is} = initial weight of samples, g
W_{fs} = final weight of samples, g

E.6 Fuel/Electrical energy consumption

E.6.1 Electrical energy consumption, E_c (kW-h/kg)

$$E_c = \frac{PcTo}{Wi}$$

where

E_c = Electrical energy consumption, kW-h/kg
P_c = Power consumed, kW
T = Time of operation, h
W_i = Total weight of input, kg

E.6.2 Fuel consumption, F_c (L/h)

$$F_c = \frac{F_l}{T}$$

where:

F_c = Fuel consumption, L/h
F_l = Amount of fuel consumed, L
T = Time of operation, h